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The Caddisflies (Trichoptera) of Stillfork Swamp Nature Preserve, Carroll County, Ohio[1,2]

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ABSTRACT. A survey of Trichoptera (caddisflies) carried out in 1984 and 1985 at Stillfork Swamp, Carroll County, Ohio resulted in a total of 7,974 adults representing nine families, 38 genera, and 104 species. *Polycentropus clinei* (Milne), *Pycnopsyche aglona* Ross, and *Frenesia difficilis* (Walker) represent new state records. Leptoceridae, the largest family, was represented by 25 species and constituted 22.5% of the total collection. The Hydropsychidae, Hydroptilidae, Limnephilidae, and Polycentropodidae included 22, 20, 15, and 13 species respectively. The most abundant genus, *Limnephilus,* was represented by two species, *indivisus* Walker and *submonilifer* Walker, both characteristic of temporary lentic waters. Seasonal distribution, species diversity, and trophic structure were evaluated. Shredders, the largest trophic category, constituted 31.7% of the species and 37.8% of the total collection.

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INTRODUCTION

During the past decade the caddisfly fauna of Ohio has been under increased investigation. Studies by Huryn and Foote (1981, 1983), MacLean and MacLean (1980, 1984), Masteller and Flint (1979), McElravy et al. (1977), McElravy and Foote (1978), and Peterson and Foote (1980) have added to the number of caddisfly species known for Ohio. Huryn and Foote (1983) reported 15 families, 55 genera, and 200 species of Trichoptera known to occur in Ohio. This represents over 83% of the families and 39% of the genera reported from North America.

Most studies of Ohio Trichoptera have focused on exclusively lotic habitats. The 69 species and 10 families of Trichoptera reported for Watercress Marsh by MacLean and MacLean (1984) demonstrated the diverse caddisfly fauna of lentic environments. Watercress Marsh, a small isolated wetlands located near the southern extent of glaciation in Columbiana County, supports a large and diverse caddisfly fauna including a number of glacial relict species.

Stillfork Swamp, a 50.6 ha wetlands, owned by The Nature Conservancy, lies 9 km northeast of Carrollton and 5 km south of Augusta on County Road 10, Carroll County, Ohio. The swamp borders Still Fork Creek (Fig. 1) in sections 34 and 35, T 15 N, R 5 W Augusta Township, and sections 12 and 18, T 14 N, R 5 W Washington Township (Stein 1974). The swamp is located several km west of the Flushing Escarpment, a dissecting Lexington Peneplain ridge of the Unglaciated Appalachian Plateau physiographic province (Stout and Lamb 1938). The surface immediately west of the Flushing Escarpment in northern Carroll County has low, narrow ridges and relatively broad, shallow, and poorly drained valleys.

Stein (1974) reported that Stillfork Swamp is "still one of a few remaining areas which serve as a refuge for many northern species. Despite extensive farming operations in the Valley, the construction of a railroad and a road through the center of the swamp, and grazing by livestock, much of the character of a northern swamp

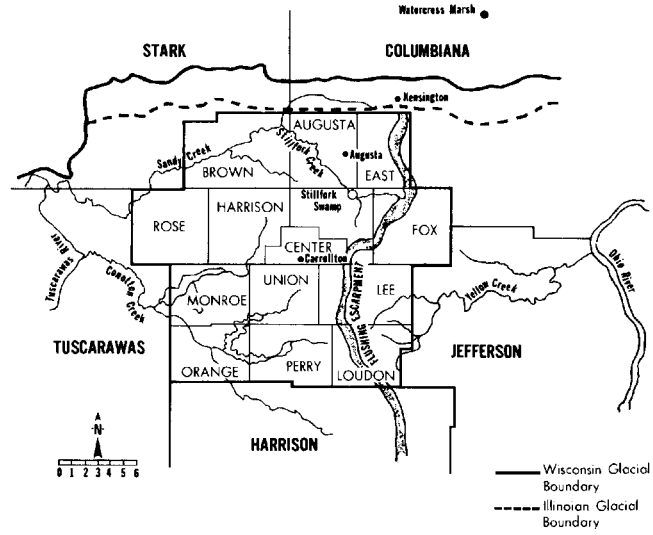

FIGURE 1. Carroll County map indicating location of Stillfork Swamp, Flushing Escarpment, Watercress Marsh, and the southern limits of glaciation.

remains." The vegetation is dominated by plants that inhabit meadow, marsh, pond, and littoral zone environments. The swamp, which is covered with water from fall to late spring, undergoes a relatively dry period from mid-July to early November. Small open water areas provide permanent aquatic habitats throughout the year. In general, temporary bodies of water exhibit a much greater amplitude of physical and chemical conditions than do most permanent aquatic habitats. Animals and plants that inhabit temporary bodies of water must be extremely tolerant of these conditions if they are to survive (Williams 1978). It is evident from the description of the vegetation and fauna (Buchanan 1980; Stein 1974) that Stillfork Swamp has supported disjunct populations of many northern species of plants and animals since glacial times.

The purpose of the present study was to evaluate the Trichoptera of an unglaciated wetland area situated near the Wisconsin glacial boundary in eastern Ohio. An intensive survey of the caddisflies of Stillfork Swamp Nature Preserve was conducted during the spring, summer, and fall of 1984 and winter of 1985. The objectives of the study were: (1) to compile a species list of caddisflies inhabiting Stillfork Swamp and (2) to quantify the tro-

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phic structure, species diversity, and seasonal distribution of adult Trichoptera occurring within the study area.

METHODS AND MATERIALS

COLLECTION SITES. Two permanent collection sites were established within the study area (Fig. 2). Site 1 was located approximately 250 m east-northeast of County Road 10 and Still Fork Creek bridge. The area was adjacent to several hectares of swamp forest and a large expanse of open swamp. Collections disclosed large numbers of *Limnephilus* larvae feeding on submerged, decaying vegetation. This site was dominated by water smartweed, *Polygonum natans* Eat., and giant bur-reed, *Sparganium eurycapum* Engelm. Vegetation bordering the swamp forest was comprised of wool-grass, *Scirpus cyperinus* (L.), blue-jointed grass, *Calamagrostis canadensis* (Michx.), swamp milkweed, *Asclepias incarnata* L., and blue-purple vervain, *Verbena hastata* L. Site 2 was located 300 m south-southeast from site 1 and was closer to Still Fork Creek. A 20-30 cm wide intermittent stream that originated from a large bur-reed and arrowhead (*Sagittaria latifolia* Willd.) swamp flowed south past the site and into Still Fork Creek. In spring, large numbers of *Ironoquia* larvae were observed feeding upon submerged, decaying grasses in this stream.

During June and July the water level in the stream dropped and was covered by an orange oxidized iron film. Hynes (1970) and Williams (1978) reported that streams in marshy areas are often covered by flocculent brown films (ferric hydroxide) characteristic of high organic matter and low pH. By early August only a muddy bottom was visible. Halberd tearthumb (*Polygonum arifolium* L.) had completely overgrown the swamp's rose thickets (*Rosa palustris* Marsh.) and buttonbushes (*Cephalanthus occidentalis* L.) that surrounded this site.

COLLECTION PROCEDURES. Collections of adult caddisflies were made at sites 1 and 2 by light traps operated during the months of May through November 1984. A total of 27 collections were made at weekly intervals according to the schedule of Lewis and Taylor (1967). Light trapping began 2 May 1984 and ended 9 November 1984. Specimens sorted from the light trap material were preserved in 80% ethanol. Collections of larvae were made irregularly during spring, fall, and winter of 1984.

McElravy (1976) compared light trap collections of caddisflies with both larval and emergence trap data and concluded that light traps provide a good representative sample of the fauna. Huryn (1982) reported that all families and most genera represented in benthic collections were also present in light trap collections. Weekly collections made throughout the season helped to maximize the completeness of the data presented in the present study. Nevertheless, light trap collection techniques have been criticized as biased measures of community structure (e.g., collections are composed only of individuals attracted to light and which enter the capture radius); therefore, any inferences of caddis community characteristics based on light trap data must be regarded with caution.

A Bendix Hygrothermograph (Model 594) was used to record continuously the relative humidity and temperature of the air from 1 June through 9 November 1984. The hygrothermograph was located approximately 25 m west of site 2 and housed in a louvered instrument shelter, approximately 20 cm above the surface. Relative humidity and temperature values were accurate to ±2.0% and ±0.5 °C, respectively.

Owing to the non-randomness of the sampling method, Pielou (1966) recommended that Brillouin's (1962) formula be used to assess the diversity of light trap collections. For this study, each collection was treated as a discrete population for the calculation of Brillouin's diversity index (H) (MacLean and MacLean 1984). Theoretical maximum diversity and evenness values were calculated according to Brower and Zar (1977).

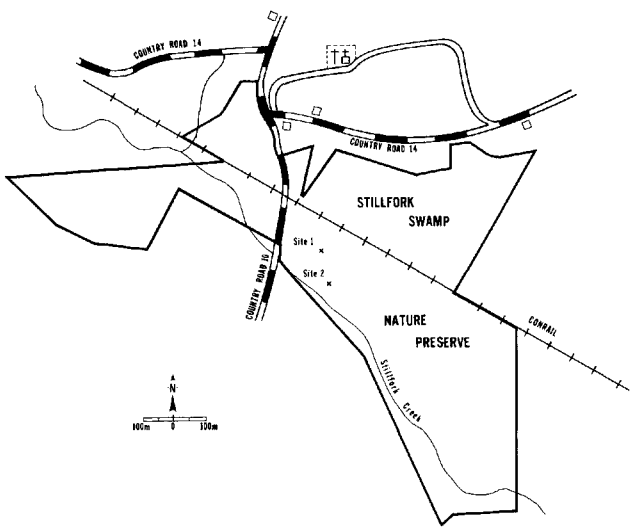

FIGURE 2. Map of Stillfork Swamp Nature Preserve, Carroll County, Ohio showing locations of collection sites 1 and 2.

RESULTS AND DISCUSSION

A total of 7,974 adult caddisflies were collected at the permanent stations established within Stillfork Swamp Nature Preserve. This total represented nine families, 38 genera, and 104 species. Larval caddisflies were also collected representing four families and nine genera. Of the 104 species collected, three were new to Ohio. A species-collection curve (Fig. 3) suggests that the majority of caddisfly species occurring at Stillfork Swamp have been recorded.

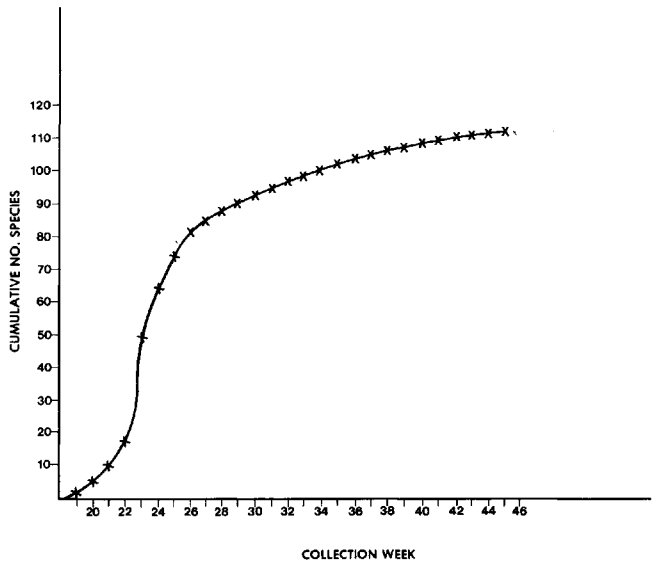

FIGURE 3. Cumulative number of Trichoptera species collected at Stillfork Swamp Nature Preserve, Carroll County, Ohio, 2 May-9 November 1984.

Dates and abundances of caddisflies collected at Stillfork Swamp during the adult emergence period of 1984 are given in the following list. Nomenclature and classification follow Wiggins (1977), except for the subfamilies Hydropsychinae and Macronematinae (Flint and Bueno 1982, Ross and Unzicker 1977, Schuster 1984). Species are listed in alphabetical order within genera. New state records are indicated by an asterisk before a species name.

Philopotamidae

Dolophilodes distinctus (Walker). VI-18-84 (1 male).

Wormaldia shawnee (Ross). VII-8-84 (1 female).

Chimarra aterrima Hagen. VIII-6-84 (1 female); IX-25-84 (1 female).

Chimarra obscura (Walker). VI-18-84 (3 females); VII-8-84 (1 male); IX-22-84 (2 males).

Psychomyiidae

Lype diversa (Banks). VI-6-84 (1 male, 5 females); VI-18-84 (1 male, 1 female); VII-14-84 (1 female).

Psychomyia flavida Hagen. VII-14-84 (1 female).

Polycentropodidae

Nyctiophylax affinis (Banks). VI-6-84 (1 male); VI-18-84 (1 male); VII-23-84 (1 male).

Nyctiophylax moestus Banks. VI-18-84 (3 males, 7 females).

Polycentropus aureolus (Banks). VI-18-84 (1 male); VI-25-84 (2 males); VII-1-84 (1 male, 1 female); VII-8-84 (9 males); VII-13-84 (1 male).

Polycentropus centralis Banks. VIII-13-84 (1 male).

Polycentropus cinereus Hagen. VI-6-84 (1 males); VI-11-84 (3 males, 1 female); VI-18-84 (6 males, 41 females); VII-8-84 (1 male, 2 females); VII-14-84 (1 female); VIII-28-84 (1 male); IX-13-84 (5 females).

**Polycentropus clinei* (Milne). VI-18-84 (1 male).

Polycentropus confusus Hagen. VI-18-84 (2 females); VII-8-84 (1 male); VII-20-84 (1 male); IX-22-84 (1 female).

Polycentropus crassicornis Walker. VI-6-84 (1 female); VI-11-84 (1 male); VI-18-84 (13 males, 29 females); VI-25-84 (1 male); VII-1-84 (2 males).

Polycentropus interruptus (Banks). VI-18-84 (1 female).

Polycentropus nr. *nascotius* Ross. IX-25-84 (2 females).

Polycentropus pentus Ross. VI-18-84 (1 female).

Polycentropus remotus Banks. VI-18-84 (2 females); IX-13-84 (1 female).

Polycentropus sp. VII-8-84 (1 female); VII-20-84 (1 female); VIII-23-84 (1 female).

Phylocentropus lucidus (Hagen). IX-13-84 (1 female).

Phylocentropus placidus (Banks). V-11-84 (1 female); VI-6-84 (2 females); VII-23-84 (1 female).

Hydropsychidae

Cheumatopsyche aphanta Ross. VI-6-84 (1 female); VI-11-84 (1 female); VI-18-84 (1 male, 10 females); VI-25-84 (1 female); VII-9-84 (1 male); VII-14-84 (3 females); VIII-13-84 (1 female).

Cheumatopsyche campyla Ross. VI-6-84 (1 male, 28 females); VI-11-84 (2 males, 5 females); VI-18-84 (30 males, 59 females); VII-8-84 (1 male, 2 females); VII-14-84 (2 males, 9 females); VII-20-84 (1 males, 11 females); VII-23-84 (3 males, 13 females); VIII-6-84 (3 females); VIII-13-84 (1 male, 2 females); VIII-28-84 (1 male, 2 females); IX-22-84 (1 female).

Cheumatopsyche gracilis (Banks). VI-18-84 (2 males, 4 females); VIII-6-84 (1 males, 4 females).

Cheumatopsyche nr. *halima* Denning. VI-18-84 (7 females).

Cheumatopsyche oxa Ross. VI-6-84 (1 female); VI-11-84 (3 females); VI-18-84 (3 males, 14 females); VII-14-84 (1 female); VII-23-84 (4 males, 2 females); VII-13-84 (1 male); VIII-6-84 (1 female).

Cheumatopsyche pettiti (Banks). V-11-84 (10 females); V-25-84 (2 females); VI-6-84 (4 males, 23 females); VI-11-84 (3 males, 51 females); VI-18-84 (45 males, 155 females); VI-25-84 (4 females); VII-1-84 (1 male, 1 female); VII-8-84 (7 males, 40 females); VII-14-84 (3 males, 28 females); VII-20-84 (23 females); VII-31-84 (9 females); VIII-6-84 (3 males, 14 females); VIII-13-84 (7 males, 18 females); VIII-28-84 (5 males, 5 females); IX-13-84 (8 males, 27 females); IX-22-84 (6 males, 3 females); IX-25-84 (34 males, 18 females); X-7-84 (1 female).

Cheumatopsyche nr. *smithi* Gordon. VI-18-84 (1 male).

Hydropsyche betteni Ross. VI-6-84 (1 male, 5 females); VI-11-84 (3 females); VI-18-84 (1 male, 15 females); VII-8-84 (7 females); VII-14-84 (1 male, 3 females); VII-23-84 (4 females); VIII-6-84 (2 females); VIII-13-84 (2 females); VIII-28-84 (3 females).

Hydropsyche dicantha Ross. VI-11-84 (1 male, 2 females); VI-18-84 (11 males, 26 females); VII-8-84 (4 females); VII-14-84 (1 female); VII-20-84 (1 female); VII-23-84 (1 female); VII-31-84 (1 female).

Hydropsyche nr. *incommoda* Hagen. VI-6-84 (2 females).

Hydropsyche orris Ross. V-25-84 (3 females); VI-6-84 (2 males, 13 females); VI-18-84 (12 males, 56 females); VII-8-84 (5 males, 9 females); VII-14-84 (2 males, 11 females); VII-20-84 (3 males, 1 female); VII-23-84 (1 male, 1 female); VIII-6-84 (2 females).

Hydropsyche phalerata Hagen. VI-18-84 (1 female); VIII-28-84 (1 female).

Hydropsyche simulans Ross. VIII-13-84 (1 male).

Hydropsyche valanis Ross. VII-20-84 (2 females); VII-23-84 (1 female); IX-8-84 (1 female).

Ceratopsyche bronta (Ross). VI-6-84 (15 females); VI-11-84 (6 females); VI-18-84 (1 male, 13 females); VII-1-84 (2 males); VII-8-84 (2 females); VII-14-84 (11 females); VII-20-84 (4 males, 8 females); VII-23-84 (3 males, 7 females); VII-31-84 (1 female); VIII-6-84 (1 female); VIII-13-84 (1 male, 4 females); IX-8-84 (3 females); IX-13-84 (1 female); IX-22-84 (1 female); IX-25-84 (1 male, 2 females).

Ceratopsyche cheilonis (Ross). VI-18-84 (1 male, 1 female); VIII-13-84 (1 male).

Ceratopsyche morosa (Hagen). VI-18-84 (1 female).

Ceratopsyche slossonae (Banks). VI-11-84 (3 females); VII-18-84 (2 males, 8 females); VII-20-84 (1 male); VII-23-84 (1 male, 1 female); VIII-6-84 (1 female); VIII-13-84 (3 females); VIII-28-84 (9 females); IX-13-84 (1 male, 3 females); IX-22-84 (10 females).

Ceratopsyche nr. *sparna* Ross. VI-18-84 (1 female).

Ceratopsyche walkeri (Betten and Mosely). VI-18-84 (1 male).

Potamyia flava (Hagen). VI-11-84 (1 female); VI-18-84 (15 males, 232 females); VII-1-84 (1 female); VII-8-84 (40 females); VII-14-84 (7 males, 42 females); VII-20-84 (11 females); VII-23-84 (3 males, 63 females); VIII-6-84 (162 females); VIII-13-84 (16 females); VIII-28-84 (4 males, 271 females); IX-8-84 (1 male); IX-13-84 (2 males, 11 females); IX-22-84 (1 male, 32 females); IX-25-84 (50 females).

Macrostemum zebratum (Hagen). VI-18-84 (1 male).

Rhyacophilidae

Rhyacophila ledra Ross. VI-18-84 (3 males).

Rhyacophila lobifera Betten. V-19-84 (2 males); V-25-84 (32 males, 5 females); VI-6-84 (1 male, 2 females).

Hydroptilidae

Agraylea multipunctata Curtis. VI-6-84 (1 female); VI-18-84 (1 male); VII-8-84 (10 females); VII-14-84 (1 female); VII-20-84 (6 females); VII-23-84 (1 female); VIII-6-84 (1 female); IX-13-84 (1 female); IX-25-84 (1 male, 5 females).

Hydroptila ajax Ross. VI-18-84 (4 males, 5 females); VII-20-84 (15 females); VII-23-84 (3 males, 4 females); VIII-6-84 (1 male, 5 females).

Hydroptila amoena Ross. VII-23-84 (1 female); IX-13-84 (1 female).
Hydroptila angusta Ross. VI-6-84 (1 male); VI-11-84 (1 male); VI-18-84 (1 male, 1 female); VII-8-84 (2 females); VII-20-84 (1 male); VII-23-84 (1 male, 1 female); VIII-6-84 (2 females); IX-22-84 (1 female); IX-25-84 (5 males, 24 females); X-13-84 (1 female).
Hydroptila consimilis Morton. VI-18-84 (26 males, 19 females); VII-8-84 (1 male); VII-14-84 (1 female); VII-23-84 (1 female); VIII-6-84 (1 male).
Hydroptila grandiosa Ross. VI-6-84 (2 females); VII-23-84 (1 female); VIII-13-84 (3 females); IX-13-84 (1 female).
Hydroptila hamata Morton. IX-13-84 (1 female).
Hydroptila jackmanni Blickle. VI-18-84 (22 males, 20 females).
Hydroptila perdita Morton. VII-8-84 (1 male); VII-23-84 (1 female); VIII-13-84 (1 female).
Hydroptila waubesiana Betten. VI-6-84 (7 females); VI-11-84 (2 females); VI-18-84 (5 females); VII-8-84 (33 males, 61 females); VII-14-84 (43 males, 296 females); VII-20-84 (37 males, 110 females); VIII-6-84 (4 females); VIII-13-84 (2 males, 17 females); VIII-28-84 (2 males, 4 females); IX-13-84 (9 males, 22 females).
Hydroptila sp. VIII-6-84 (1 female).
Ochrotrichia spinosa (Ross). VI-18-84 (11 males, 3 females).
Ochrotrichia sp. VI-18-84 (1 female); VII-8-84 (1 female).
Oxyethira nr. *dualis* Morton. VI-18-84 (1 female); VIII-8-84 (3 females); VIII-6-84 (1 male, 3 females); IX-22-84 (3 females); IX-25-84 (1 female).
Oxyethira forcipata Mosely. VII-8-84 (2 males); VII-23-84 (2 males); VIII-6-84 (2 males); VIII-13-84 (1 male); VIII-28-84 (1 male).
Oxyethira pallida (Banks). VI-18-84 (1 male, 1 female); VII-8-84 (8 females); VII-14-84 (1 male, 4 females); VII-20-84 (2 males, 8 females); VII-23-84 (9 males, 26 females); VII-31-84 (1 female); VIII-6-84 (2 males, 28 females); VIII-13-84 (1 male, 9 females); VIII-28-84 (2 males, 2 females); IX-13-84 (2 males, 16 females); IX-22-84 (7 males, 39 females); IX-25-84 (1 male, 33 females); X-7-84 (1 male, 6 females); X-13-84 (3 females); X-20-84 (1 male, 67 females); X-26-84 (2 males, 27 females); XI-2-84 (6 females).
Oxyethira sp. VII-1-84 (1 female); VII-14-84 (1 female); VIII-6-84 (1 female).
Stactobiella palmata (Ross). VI-18-84 (1 male).
Orthotrichia aegerfasciella (Chambers). VI-6-84 (1 male); VI-18-84 (19 males, 30 females); VI-25-84 (1 male, 1 female); VII-8-84 (5 males, 11 females); VII-14-84 (2 males, 1 female); VII-20-84 (17 males, 6 females); VII-23-84 (20 males, 10 females); VII-31-84 (3 males, 2 females); VIII-6-84 (25 males, 12 females); VIII-13-84 (45 males, 13 females); VIII-20-84 (1 male); VIII-28-84 (1 male, 1 female); IX-13-84 (1 male); IX-25-84 (1 female).
Orthotrichia cristata Morton. VI-18-84 (5 males, 1 female); VII-1-84 (1 female); VII-8-84 (4 males, 1 female); VII-14-84 (2 males, 2 females); VII-23-84 (1 female); VII-31-84 (1 male).
Neotrichia sp. VII-23-84 (1 female).

Phryganeidae

Agrypnia straminea Hagen. IX-22-84 (1 female); IX-25-84 (7 females); X-7-84 (1 male, 1 female).
Agrypnia vestita (Walker). VIII-28-84 (4 males, 3 females); IX-8-84 (4 males, 5 females); IX-13-84 (6 males, 9 females); IX-22-84 (6 males); IX-25-84 (1 male).
Banksiola crotchi Banks. VI-18-84 (1 female); VII-23-84 (1 male); VIII-6-84 (1 male).
Banksiola dossuaria (Say). VI-18-84 (1 male, 1 female).
Phryganea sayi Milne. VII-23-84 (1 male); VIII-6-84 (6 males, 6 females); VIII-13-84 (4 males, 7 females); VIII-28-84 (9 males, 3 females); IX-8-84 (1 female); IX-13-84 (10 males, 16 females); IX-22-84 (1 female); IX-25-84 (1 male).
Ptilostomis ocellifera (Walker). VI-6-84 (3 females); VI-18-84 (6 males, 9 females); VII-1-84 (1 female); VII-8-84 (2 females); VII-14-84 (1 male, 6 females); VII-20-84 (11 females); VII-23-84 (5 females); VII-31-84 (4 males, 1 female); VIII-6-84 (3 females); IX-22-84 (1 female).
Ptilostomis postica (Walker). VI-6-84 (1 female); VIII-13-84 (1 female); VIII-20-84 (1 male); VIII-28-84 (2 females); IX-22-84 (1 male); IX-25-84 (1 male).

Limnephilidae

Ironoquia parvula (Banks). IX-25-85 (2 males); X-5-84 (1 female); X-7-84 (19 males, 2 females); X-13-84 (1 male).
Ironoquia punctatissima (Walker). VIII-28-84 (42 males, 25 females); IX-8-84 (5 males, 6 females); IX-13-84 (114 males, 40 females); IX-22-84 (12 males, 12 females); IX-25-85 (19 males, 16 females); X-7-84 (1 male, 2 females); X-13-84 (1 male, 1 female).
Hydatophylax argus (Harris). VI-6-84 (1 female).
**Pycnopsyche aglona* Ross. IX-22-84 (1 male); IX-25-84 (5 males); X-7-84 (39 males, 1 female); X-13-84 (10 males, 6 females).
Pycnopsyche divergens (Walker). VIII-28-84 (1 male).
Pycnopsyche guttifer (Walker). IX-13-84 (1 male); X-20-84 (1 male).
Pycnopsyche indiana (Ross). X-7-84 (11 males, 2 females).
Pycnopsyche lepida Hagen. IX-13-84 (1 male); IX-22-84 (2 males); IX-25-84 (2 males); X-13-84 (1 male).
Anabolia consocius (Walker). VII-1-84 (1 male); VIII-28-84 (1 male); IX-13-84 (3 males, 2 females); IX-22-84 (5 males); IX-25-84 (2 males); X-13-84 (1 male).
Limnephilus indivisus Walker. V-25-84 (1 female); VI-18-84 (1 male, 3 females); VIII-13-84 (1 male, 1 female); VIII-28-84 (10 males, 9 females); IX-8-84 (9 males, 5 females); IX-13-84 (157 males, 176 females); IX-22-84 (85 males, 102 females); IX-25-84 (129 males, 114 females); X-5-84 (2 males, 4 females); X-7-84 (11 males, 21 females); X-13-84 (6 males, 3 females); X-20-84 (1 male, 1 female); X-26-84 (1 male).
Limnephilus submonilifer Walker. V-11-84 (7 males, 12 females); V-19-84 (1 male, 6 females); V-25-84 (11 males, 6 females); VI-2-84 (2 females); IX-8-84

(4 males); IX-13-84 (30 males, 18 females); IX-22-84 (31 males, 41 females); IX-25-84 (95 males, 28 females); X-5-84 (1 female); X-7-84 (54 males, 41 females); X-13-84 (32 males, 6 females); X-20-84 (45 males, 9 females); X-26-84 (39 males, 2 females); XI-2-84 (12 males, 1 female).

Platycentropus radiatus (Say). VII-14-84 (1 female); VII-20-84 (1 female).

**Frenesia difficilis* (Walker). XI-2-84 (1 male); XI-9-84 (2 males).

Frenesia missa (Milne). XI-2-84 (3 males); XI-9-84 (16 males).

Neophylax concinnus McLachlan. X-7-84 (1 female); X-13-84 (4 females); X-20-84 (1 male).

Leptoceridae

Ceraclea alagma (Ross). VI-18-84 (4 males); VI-24-84 (1 male); VII-8-84 (1 male).

Ceraclea cancellata (Betten). VI-18-84 (1 male, 1 female).

Ceraclea nr. *diluta* (Hagen). VI-18-84 (5 females).

Ceraclea flava (Banks). VII-14-84 (1 male).

Ceraclea maculata (Banks). VII-14-84(1 male); VII-8-84 (1 male); VIII-6-84 (2 females).

Ceraclea tarsipunctata (Vorhies). VI-18-84 (11 males, 14 females); VI-25-84 (1 male); VII-1-84 (3 males); VII-8-84 (1 male, 2 females); VII-14-84 (1 female); VII-23-84 (1 female).

Ceraclea transversa (Hagen). VI-18-84 (18 males, 37 females); VII-8-84 (5 males, 1 female); VII-20-84 (2 females); VII-23-84 (2 males, 1 female); VIII-6-84 (2 males, 2 females).

Leptocerus americanus (Banks). VI-18-84 (2 males, 2 females); VII-1-84 (3 males); VII-8-84 (2 females); VII-14-84 (1 female); VII-23-84 (1 female).

Nectopsyche nr. *albida* (Walker). VI-6-84 (1 female).

Nectopsyche candida (Hagen). VI-18-84 (6 females); VII-14-84 (3 males, 10 females); VIII-13-84 (1 female); VIII-28-84 (2 females).

Nectopsyche diarina (Ross). VI-6-84 (4 females); VI-11-84 (22 females); VI-18-84 (69 females); VI-25-84 (1 female); VIII-6-84 (5 females); VIII-13-84 (3 females); VIII-28-84 (3 females).

Nectopsyche sp. VII-8-84 (14 females); VII-20-84 (3 females); VII-23-84 (2 females).

Triaenodes abus Milne. VI-18-84 (1 female).

Triaenodes dipsius Ross. VI-18-84 (1 male).

Triaenodes flavescens Banks. VII-8-84 (1 female); VII-14-84 (2 females); VII-23-84 (2 females); VIII-13-84 (2 females).

Triaenodes injustus (Hagen). VI-18-84 (2 males, 1 female); VII-14-84 (1 male, 1 female).

Triaenodes marginatus Sibley. VI-6-84 (3 males, 6 females); VI-11-84 (3 males, 26 females); VII-1-84 (30 females); VII-8-84 (11 males, 85 females); VII-14-84 (1 male, 27 females); VII-20-84 (17 females); VII-23-84 (2 males, 18 females); VII-31-84 (3 females); VIII-6-84 (29 females); VIII-13-84 (5 males, 33 females); VIII-28-84 (2 males, 49 females).

Triaenodes tardus Milne. VI-6-84 (1 male, 6 females); VI-11-84 (1 male, 1 female); VI-18-84 (1 male, 2 females); VI-25-84 (2 males); VII-8-84 (1 male, 2 females); VII-20-84 (1 female); VII-23-84 (1 male, 2 females); VII-31-84 (1 female); VIII-6-84 (1 male, 26 females); VIII-28-84 (1 male, 3 females); IX-13-84 (1 male, 61 females); IX-22-84 (2 males, 8 females); IX-25-84 (3 males, 8 females).

Oecetis cinerascens (Hagen). VI-6-84 (1 male); VI-11-84 (4 males); VI-18-84 (6 males, 3 females); VI-25-84 (2 males); VII-1-84 (1 male); VII-8-84 (1 male); VII-14-84 (1 male, 1 female); VII-20-84 (2 males); VII-23-84 (1 male); VIII-6-84 (3 males); VIII-13-84 (2 males, 1 female); VIII-28-84 (2 females); IX-25-84 (2 females).

Oecetis ditissa Ross. VI-11-84 (2 females); VI-18-84 (1 male, 16 females); VI-25-84 (3 males); VII-8-84 (1 male, 2 females); VII-14-84 (1 male, 1 female); VIII-13-84 (1 male, 2 females); VIII-28-84 (1 female); IX-13-84 (2 females); IX-22-84 (l male).

Oecetis inconspicua (Walker). VI-6-84 (14 males, 7 females); VI-11-84 (50 males, 28 females); VI-18-84 (151 males, 172 females); VI-25-84 (23 females); VII-1-84 (15 males, 7 females); VII-8-84 (32 males, 33 females); VII-14-84 (8 males, 11 females); VII-20-84 (32 males, 16 females); VII-23-84 (54 males, 57 females); VII-31-84 (6 males, 1 female); VIII-6-84 (15 males, 12 females); VIII-13-84 (16 males, 17 females); VIII-28-84 (6 females); IX-25-84 (1 male, 5 females).

Oecetis nocturna Ross. VI-18-84 (1 male, 1 female); VII-8-84 (1 male); VIII-6-84 (2 males, 4 females); VIII-13-84 (1 female); VIII-28-84 (1 male, 2 females).

Oecetis nr. *ochracea* (Curtis). VIII-6-84 (1 male, 1 female); VIII-13-84 (3 females).

Oecetis sp. VI-18-84 (1 female).

CADDISFLY FAUNA. Four families, the Leptoceridae, Hydropsychidae, Hydroptilidae, and Limnephilidae included 74% of the species collected at Stillfork Swamp (Table 1). The Leptoceridae were represented by 25 species constituting 24.8% of the number of individuals collected. *Triaenodes marginatus* and *Oecetis inconspicua* accounted for 8.1 and 10.1% of the season's total, and occurred in 13 and 17 collections, respectively. Although *T. tardus* made up less than 2% of the total, it occurred in half of the collections.

The 22 species of Hydropsychidae were more abundant than the Leptoceridae and represented 27.5% of the cad-

TABLE 1

Numerical abundance of caddisfly families collected by light traps operated at Stillfork Swamp Nature Preserve, Carroll County, Ohio, 2 May-9 November 1984.

Family	Number of individuals	% of seasonal total	Number of species	% of species
Philopotamidae	10	0.1	4	3.6
Psychomyiidae	10	0.1	2	1.8
Polycentropodidae	168	2.1	13	12.6
Hydropsychidae	2190	27.5	22	19.8
Rhyacophilidae	45	0.6	2	1.8
Hydroptilidae	1563	19.6	20	18.0
Phryganeidae	168	2.1	7	6.3
Limnephilidae	1845	23.1	15	13.5
Leptoceridae	1975	24.8	25	22.5

disfly collection. *Cheumatopsyche campyla* and *C. pettiti* occurred in 40.7 and 66.7% of the collections, respectively. *Potamyia flava,* the most abundant species (12.1% of the total), was present in 15 collections. *Hydropsyche orris* comprised only 1.5% of the seasonal total but was collected on nine occasions.

The 20 species of Hydroptilidae were the third largest assemblage of Trichoptera and comprised 19.6% of the seasonal total. *Hydroptila waubesiana,* the most abundant hydroptilid, occurred in 44.4% of the collections. Likewise, *Orthotrichia aegerfasciella* made up 2.9% of the total but occurred in over half of the collections.

The 15 species of Limnephilidae comprised 23.1% of the seasonal total and collectively were more abundant than the Hydroptilidae. Although represented by only two species, the genus *Limnephilus* was the most abundant at Stillfork Swamp comprising 17.4% of the entire collection. *L. indivisus* was the second most abundant species and appeared in 44.4% of the collections. *L. submonilifer* and *Ironoquia punctatissima* were present in 48.1 and 25.9% of the collections, respectively.

ADULT SEX RATIOS. Sex ratios were determined for species present in 25% or more of the collections and represented by 100 or more individuals (Table 2). For most species, females predominated (32.4 to 100%). These findings, similar to those of Anderson and Wold (1972) and Resh et al. (1975), suggest that sexes of some Trichoptera exhibit preferential attraction to light. MacLean and MacLean (1984) observed that male *Potamyia flava* displayed very limited attraction to light. Similar results from Stillfork Swamp revealed that a high proportion of *P. flava* adults attracted to light were females (Table 2). Whereas all individuals of *Nectopsyche diarina* were female, 67.6% of *Limnephilus submonilifer* were males. It was commonly observed that males of most Limnephilidae emerged prior to females. Since caddisfly pupae were not collected, it was not known whether the data reflected preferential attraction to light or actual differences in adult sex ratios.

TABLE 2

Sex ratios of selected species of adult caddisflies based on light trap collections from Stillfork Swamp, Carroll County, Ohio, 2 May-9 November 1984.

Taxon	Total No. individuals in collection	% Females in light trap collection	% Samples in which species occurred	% of seasonal total
Hydropsychidae				
Cheumatopsyche campyla	177	76.2	40.7	2.2
C. pettiti	618	78.5	66.7	7.8
Hydropsyche orris	121	79.5	29.6	1.5
Potamyia flava	965	96.5	48.1	12.1
Hydroptilidae				
Hydroptila waubesiana	702	79.7	44.4	8.8
Oxyethira pallida	356	91.0	62.9	4.5
Orthotrichia aegerfasciella	229	38.4	51.9	2.9
Limnephilidae				
Ironoquia punctatissima	296	34.5	25.9	3.7
Limnephilus indivisus	853	51.6	44.4	10.7
L. submonilifer	534	32.4	48.1	6.7
Leptoceridae				
Nectopsyche diarina	107	100.0	25.9	1.3
Triaenodes marginatus	642	92.2	40.7	8.1
T. tardus	138	89.1	51.9	1.7
Oecetis inconspicua	804	47.5	55.6	10.1

SEASONAL DISTRIBUTION. Many species exhibited flight periods that extended over several months. Fourteen species were collected continuously, or nearly so, from late May through mid-September. Many species showed a peak abundance in late spring, followed by a second smaller peak in early fall. Adults of 32 species were taken for only short periods (one or two consecutive collections). The emergence pattern observed at Stillfork Swamp was similar to the seasonal distribution of Trichoptera for western Lake Erie (Marshall 1939).

Adults of *Ironoquia, Pycnopsyche, Frenesia,* and *Neophylax* appeared during the months of September, October, and November and were considered an "autumn" group. Adults of *Limnephilus indivisus* and *L. submonilifer* displayed the dual flight pattern (MacLean and MacLean 1984, McElravy 1976, Wiggins 1973), appearing first in spring and again in late summer and early fall. Many of the remaining species consisted of a "summer" group and emerged from late May to August, with peak abundance in June. Species that exhibited two abundance peaks were *Potamyia flava, Cheumatopsyche pettiti,* and *Oxyethira pallida. P. flava* had an extended flight period (June to October) and displayed peaks in mid-June and late-August. *C. pettiti* peaked in mid-July and again in late-October. While *O. pallida* was present in 63% of the collections, its annual cycle may be either univoltine, with sequential cohorts, or bivoltine. A bivoltine species of *Oxyethira* has been recorded for Denmark (Nielsen 1948).

Many species did not occur in large numbers (e.g., *Nyctiophylax moestus, Rhyacophila ledra, Hydroptila jackmanni,* and *Oecetis* nr. *ochracea* were collected only once).

SPECIES DIVERSITY. An analysis of community characteristics is presented in Table 3. Values of species diversity (H), and evenness (J) calculated for each collection week were basically similar to those reported by MacLean and MacLean (1984) for Watercress Marsh. Values of H gradually increased during the month of May, and by mid-June reached their highest level. Diversity decreased during August, increased to a second peak by mid-September, and then slowly declined. A total of 66 species were collected on 18 June 1984, the largest number for a single collection. Large collections greatly increased the number of rare species.

TEMPERATURE. Mean air temperatures recorded at the swamp for the period of 2 June to 2 November 1984 are given in Table 4. Significant correlations of collection size (N) and species diversity (H) with temperature ($r = 0.791$ and $r = 0.978$, respectively, $P < 0.001$) suggest that a minimum threshold temperature may be necessary for flight activity. This observation agrees with previous studies that temperature is a significant factor in determining the size of light trap collections (Nimmo 1966, Resh et al. 1975).

TROPHIC STRUCTURE. Cummins (1973) categorized the feeding mechanism of aquatic insects into "functional groups" based on trophic relations (i.e., shredders, grazers, collectors, predators, and piercers). These categories define the roles of insect taxa in aquatic ecosystems with respect to processing organic matter. Wiggins and Mackay (1978) proposed that Trichoptera

TABLE 3

Number of species (S), collection size (N), Brillouin's diversity index (H), and evenness (J) for 27 weekly Trichoptera collections from Stillfork Swamp, Carroll County, Ohio.

Week[a]	Dare	S	N	H	J
19	V-11-84	3	30	0.293	0.689
20	V-19-84	2	9	0.067	0.525
21	V-25-84	5	60	0.386	0.601
22	VI-2-84	1	2	0.151	1.000
23	VI-6-84	28	170	1.067	0.803
24	VI-11-84	19	226	0.826	0.644
25	VI-18-84	66	1826	1.230	0.683
26	VI-25-84	12	43	0.369	0.910
27	VII-8-84	39	475	1.065	0.918
28	VII-14-84	31	560	0.722	0.502
29	VII-20-84	25	360	0.916	0.672
30	VII-23-84	39	453	1.041	0.664
31	VII-31-84	13	38	1.051	0.798
32	VIII-6-84	33	407	0.964	0.654
33	VIII-13-84	30	257	1.048	0.727
34	VIII-20-84	2	2	0.151	0.500
35	VIII-28-84	27	499	0.723	0.484
36	IX-8-84	8	44	0.640	0.761
37	IX-13-84	24	765	0.801	0.543
38	IX-22-84	24	429	1.056	0.649
39	IX-25-84	24	624	0.950	0.710
40	X-7-84	10	223	0.673	0.693
41	X-13-84	11	80	0.643	0.666
42	X-20-84	5	126	0.344	0.516
43	X-26-84	3	111	0.293	0.660
44	XI-2-84	4	22	0.346	0.637
45	XI-9-84	2	19	0.182	0.452

[a]Lewis and Taylor (1967)

functional groups correspond well at the generic level. The use of functional groups enables the numerical assessment of the invertebrate biota and its relationship with a particular resource to be understood more clearly. Specifically, it better defines the link between resources and insect morpho-behavioral adaptations (Cummins 1973).

The trophic structure (Wiggins 1984) inferred from light trap collections is summarized in Table 5. The largest category was the shredder functional group (33 species, 4 families) comprising 37.8% of the caddisfly population. The importance of this trophic category is consistent with results reported by MacLean and MacLean (1984) for Watercress Marsh and reflects the predominant lentic nature of the wetland ecosystem. The collector (31 species, 5 families) and predator (24 species, 4 families) categories were the next largest trophic groups. Piercers (14 species, 2 families), comprised almost exclusively of Hydroptilidae, represented 19.5% of the population. The scraper or grazing trophic category was represented by only two species.

Very little is known about the trophic relationships of caddisflies inhabiting wetland ecosystems. The observed trophic structure of Stillfork Swamp contrasts with that of higher order lotic ecosystems, where processing of fine

TABLE 5

Trophic categories of Stillfork Swamp Trichoptera inferred from adult light trap collections.

Functional group[a]	No. species	% of species	No. of individuals	% of Total
Shredders	33	31.7	3000	37.8
Collectors	31	29.8	2221	27.9
Predators	24	23.1	1166	14.6
Piercers	14	13.5	1545	19.5
Scrapers	2	1.9	15	0.2

[a]Wiggins (1984)

TABLE 4

Mean air temperatures (°C) recorded at Stillfork Swamp, Carroll County, Ohio, 2 June-2 November 1984.

Week[a]	Date	Mean air temperature during light trap operation	Range	Mean nightly air temperature for collection period	Range
22	VI-2-84	13.1	(16.7- 9.4)	16.6	(26.7- 6.7)
23	VI-6-84	19.7	(22.2-17.2)	20.6	(22.2-17.2)
24	VI-11-84	16.1	(19.4-12.8)	18.1	(28.1- 8.9)
25	VI-18-84	21.7	(23.3-20.0)	19.8	(25.0-10.6)
26	VI-25-84	15.3	(17.8-12.8)	16.3	(22.8- 7.2)
27	VII-8-84	16.9	(18.1-15.8)	18.7	(25.7-13.6)
28	VII-14-84	19.2	(21.7-16.7)	17.1	(25.8- 8.3)
29	VII-20-84	17.5	(18.9-16.1)	17.4	(23.3-12.2)
30	VII-23-84	19.2	(21.7-16.7)	15.9	(21.7- 8.9)
31	VII-31-84	16.7	(20.0-13.3)	19.0	(23.3-11.1)
32	VIII-6-84	20.0	(21.7-18.3)	20.5	(24.7-16.1)
33	VIII-13-84	19.7	(21.7-18.3)	17.6	(22.8-11.7)
34	VIII-20-84	10.8	(13.9- 7.8)	12.8	(21.1- 3.9)
35	VIII-28-84	20.0	(22.8-17.2)	16.3	(22.8-11.7)
36	IX-8-84	12.8	(16.1- 9.4)	13.6	(23.3- 2.5)
37	IX-13-84	19.4	(20.6-18.3)	12.4	(20.6- 1.1)
38	IX-22-84	16.9	(19.4-14.4)	19.2	(22.2-14.4)
39	IX-25-84	20.3	(21.1-19.4)	9.9	(21.1- 0.6)
40	X-7-84	14.7	(15.5-13.9)	13.2	(20.6- 2.2)
41	X-13-84	13.3	(13.3-13.3)	13.8	(22.5- 5.6)
42	X-20-84	16.4	(18.9-13.9)	11.6	(20.6- 3.3)
43	X-26-84	14.4	(15.5-13.9)	12.2	(23.9- 2.2)
44	XI-2-84	12.2	(15.5- 8.9)	10.9	(23.1- 1.1)

[a]Lewis and Taylor (1967)

particulate organic matter and periphyton through the collector and scraper trophic categories predominates (Huryn 1982, Hynes 1970).

ADAPTATIONS TO TEMPORARY POOLS. Stillfork Swamp provides an ideal habitat for a large number of Trichoptera that have adapted to temporary bodies of water. Wiggins (1973) recognized and defined types of temporary pools as: (1) vernal pools that contain water for only a few months of the year (March-June) and (2) autumnal pools that contain water for nine months of the year (October-July). Stillfork Swamp can be classified as a temporary autumnal wetland. Caddisflies that have adapted to seasonal dry periods by means of diapause, oviposition apart from water, and gelatinous egg masses (Wiggins 1973) belong primarily to the Limnephilidae, Phryganeidae, and Polycentropodidae.

Limnephilus indivisus, whose life history has been well documented (Wiggins 1973), was the dominant shredder. Observations made on 10 February 1985 revealed that first and second instar larvae survive the winter under thick ice that covered the shallow ponds. All surface water had been evaporated or absorbed, leaving a 5 cm insulated air space between the ice and the soil. Dormant larvae, within cases attached to decaying vegetation, were covered with ice crystals but were not frozen. Temperature of the air space was 1°C whereas the air temperature was −4°C. Similar behavior was observed for larvae of *Ironoquia punctatissima* that inhabited the temporary stream passing through site 2. First and second instars were buried in the moist mud while the streambed was covered with ice and free of water during the winter months.

In summary, Stillfork Swamp supports a large and diverse caddisfly fauna that reflects the high environmental quality of this site. Since the swamp comprises a relatively small area, any disturbance that would permanently alter the surrounding watershed or watertable would have serious effects on the biota of the preserve. Efforts to convert natural wetlands to other purposes have resulted in their wholesale destruction. As a result of their unique and distinctive character, temporary lentic and lotic habitats within Stillfork Swamp should be preserved by protecting the surrounding watershed.

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